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SOLAR/1057-78/11

Monthly Performance Report

ZEIN MECHANICAL CONTRACTORS NO. 1

NOVEMBER 1978

U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

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MONTHLY PERFORMANCE REPORT

ZEIN MECHANICAL CONTRACTORS NO. 1

NOVEMBER 1978

I. SYSTEM DESCRIPTION

Zein Mechanical Contractors No. 1 is a single family residence in Milwaukee, Wisconsin. The home has approximately 1304 square feet of conditioned space. The solar energy system consists of two independently controlled systems: one system serves domestic hot water (DHW) preheating, the other is used for space heating and space cooling. Only the space heating and cooling system is described in this report.

The system has an array of flat-plate collectors with a gross area of 384 square feet. The array faces south at an angle of 53 degrees to the horizontal. Air is the transfer medium that delivers solar energy from the collector array to storage. Solar energy is stored in a rock bin containing 41,250 pounds of rock located in the basement of the house. The rock bin has 2 inches of polyurethane insulation on the outside walls and fiberglass roll insulation in the ceiling. A heat pump delivers solar energy from storage to a heat exchanger located within an air-handler. Heated air is then blown from the air-handler to the load. When solar energy is insufficient to satisfy the space heating load, an electric resistance heater in the air-handler provides auxiliary energy for space heating. The system, shown schematically in Figure 1, has 10 modes of solar operation for space conditioning.

Mode 1 - Storage-to-Heat Pump-to-Space Heating: This winter mode activates when there is a demand for space heating, the collector loop is not active, and the outside ambient temperature is less than 10°F above the rock bed temperature. Air is drawn through motorized dampers from storage by the collector/heat pump circulating fan, past the heat pump evaporator coil, bypassing the collector, and returns to storage. The heat pump condenser coil and house circulating fan supply energy to the house and electrical strip heaters supplement the heat pump to meet the heating demand.

Mode 2 - Collector-to-Storage: This winter mode activates when the temperature difference between the collector outlet and storage is 10°F or higher, and the outside ambient temperature is less than 10°F above the rock bed temperature. Air is drawn from the collector by the collector/heat pump circulating fan and goes into the rock bin through motorized dampers and then recirculates through the collector. There may or may not be a demand for space heating.

Mode 3 - Outside Air-to-Rock Bed: This mode activates when the collector loop is inactive, there is no demand for space heating, and the outside ambient temperature is higher than 10°F above the rock bed temperature. Air is drawn from the outside by the collector/heat pump circulating fan and goes into the rock bin through motorized dampers and then exhausts to the outside through a backdraft damper in the wall of the insulated room.

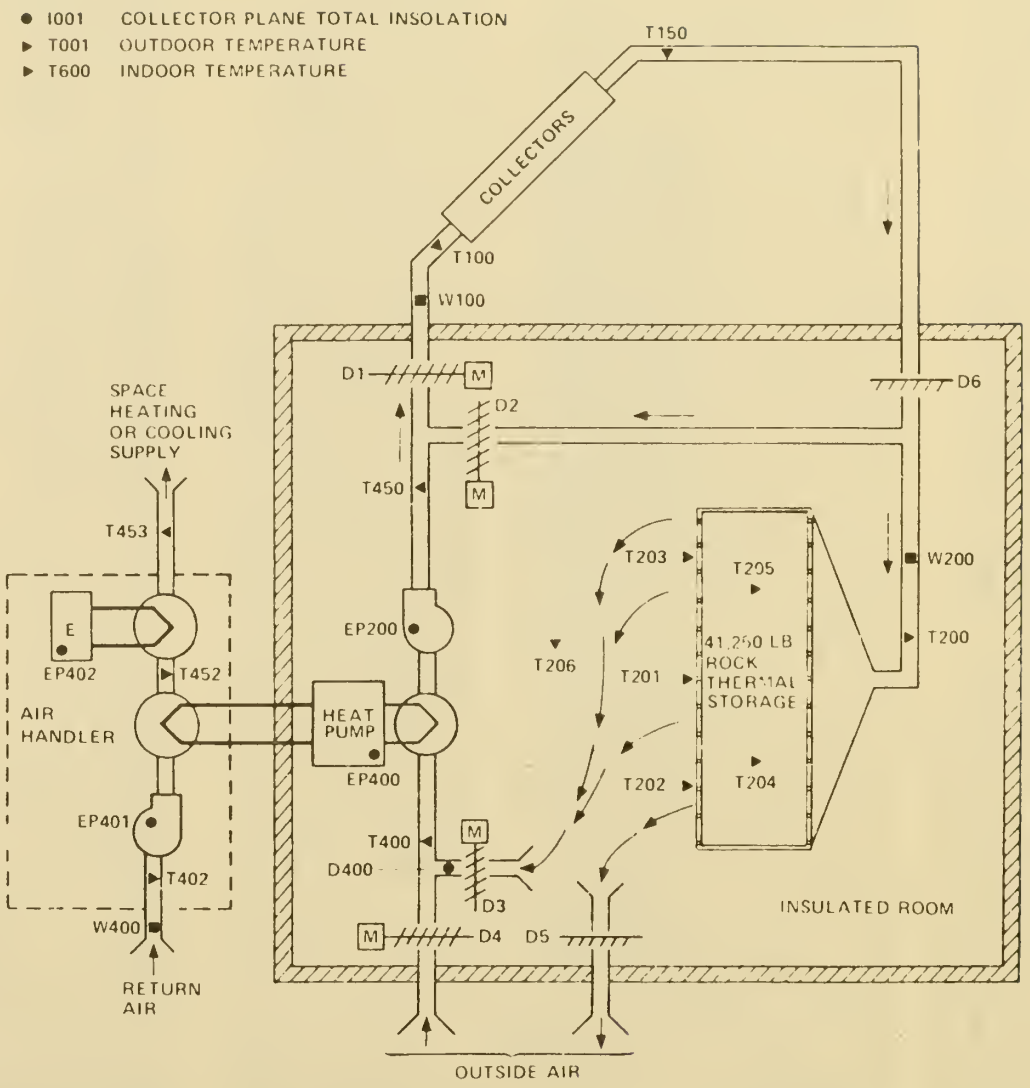

Figure 1. ZEIN MECHANICAL NO. 1 SOLAR ENERGY SYSTEM SCHEMATIC

Mode 4 - Outside Air-to-Heat Pump-to-Space Heating: This winter mode activates when there is a demand for space heating, the collector loop is not active, and the outside ambient temperature is more than 10°F above the rock bed temperature. Air is drawn from the outside through motorized dampers, past the heat pump evaporator coil, through the storage bin, and then exhausts to the outside through a backdraft damper in the wall of the insulated room. The heat pump condenser coil and house circulating fan supply energy to the house. Electric strip heaters supplement the heat pump to meet the heating demand.

Mode 5 - Outside Air-to-Collector-to-Rock Bed: This mode activates when the difference in temperature between the collector outlet and storage is 10°F or higher, and the outside ambient temperature is more than 10°F above the rock bed temperature. Air is drawn from the outside by the collector/ heat pump circulating fan, goes through the collector and into the rock bin through motorized dampers, and then exhausts to the outside. There may or may not be a demand for space heating.

Mode 6 - Storage-to-Heat Pump-to-Space Cooling: This summer mode activates when there is a demand for space cooling, the collector loop is not active, and the rock bed temperature is less than 10°F above the outside ambient temperature. Air is drawn through motorized dampers from storage by the collector/heat pump fan, past the heat pump condenser coil, bypassing the collector, and returns to storage. The heat pump evaporator coil and house circulating fan remove energy from the house.

Mode 7 - Collector-to-Storage for Cooling: This mode rejects rock bed energy by circulating air through the collector at night. This summer mode activates when the temperature difference between the rock bed and the collector outlet is 10°F or higher, and the rock bed temperature is less than 10°F above the outside ambient temperature. Air is drawn from the collector at night by the collector/heat pump circulating fan and goes into the rock bin through motorized dampers and then recirculates through the collector. There may or may not be a demand for space cooling.

Mode 8 - Outside Air-to-Rock Bed for Cooling: This mode activates when the collector loop is inactive, there is no demand for space cooling, and the rock bed temperature is more than 10°F above the outside ambient temperature. Air is drawn from the outside by the collector/heat pump circulating fan and goes into the rock bin through motorized dampers and then exhausts to the outside through a backdraft damper in the wall of the insulated room.

Mode 9 - Outside Air-to-Heat Pump-to-Space Cooling: This summer mode activates when there is a demand for space cooling, the collector loop is not active, and the rock bed temperature is more than 10°F above the outside ambient temperature. Air is drawn from the outside through motorized dampers to the heat pump, past the heat pump condenser coil, through the storage bin, and then exhausts to the outside through a backdraft damper in the wall of the insulated room. The heat pump evaporator coil and house circulating fan remove energy from the house to meet the cooling load.

Mode 10 - Outside Air-to-Collector-to-Rock Bed: This mode activates when the temperature difference between the rock bed and collector outlet is 10°F or

higher, and the rock bed temperature is higher than 10°F above the outside ambient temperature. Air is drawn from the outside by the collector/heat pump circulating fan, goes into the rock bin through motorized dampers, and is then exhausted to the outside. There may or may not be a demand for space cooling.

II. PERFORMANCE EVALUATION

INTRODUCTION

The site was unoccupied in November; however, the solar energy system operated continuously during the month. Solar energy satisfied 52 percent of the space heating requirements. The solar energy system provided an electrical energy savings of 0.48 million Btu.

WEATHER CONDITIONS

During the month, total incident solar energy on the collector array was 9.7 million Btu for a daily average of 846 Btu per square foot. This was below the estimated average daily solar radiation for this geographical area during November of 927 Btu per square foot for a south-facing plane with a tilt of 53 degrees to the horizontal. The average ambient temperature during November was 37°F and was equal to the long-term average.

THERMAL PERFORMANCE

Collector - The total incident solar radiation on the collector array for the month of November was 9.7 million Btu. During the period the collector loop was operating the total insolation amounted to 9.3 million Btu. The total collected solar energy for the month of November was 4.3 million Btu, resulting in a collector array efficiency of 44 percent, based on total incident insolation. Solar energy delivered from the collector array to storage was 4.3 million Btu. Operating energy required by the collector loop was 0.36 million Btu.

Storage - Solar energy delivered to storage was 4.3 million Btu. There were 1.4 million Btu delivered from storage to the space heating system. Energy loss from storage was 3.3 million Btu. This loss represented 78 percent of the energy delivered to storage. The storage efficiency was 22 percent: This is calculated as the ratio of the sum of the energy removed from storage and the change in stored energy, to the energy delivered to storage. The average storage temperature for the month was 72°F.

Space Heating Load - The space heating system consumed 1.4 million Btu of solar energy and 1.3 million Btu of auxiliary electrical energy to satisfy a space heating load of 2.6 million Btu. The solar fraction of this load was 52 percent. The space heating system consumed a total of 0.79 million Btu of operating energy, resulting an an electrical energy savings of 0.84 million Btu.

OBSERVATIONS

The large storage losses are attributed to leakage from the collector loop. This caused make-up air to be drawn into the insulated room through outside air vents.

ENERGY SAVINGS

The space heating system provided an electrical energy savings of 0.84 million Btu. The net electrical energy savings for the solar energy system was 0.48 million Btu.

III. ACTION STATUS

No action is planned for this site.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: ZEIN MECHANICAL-NO. 1 SOLAR/1057-78/11
REPORT PERIOD: NOVEMBER,1978

SITE/SYSTEM DESCRIPTION:
THE ZEIN MECHANICAL NO. 1 SOLAR ENERGY SYSTEM UTILIZES A SOLAR ASSISTED HEAT PUMP TO HEAT AND COOL A 1304 SQ FT SINGLE FAMILY DWELLING. THE COLLECTION SUBSYSTEM CONSISTS OF 384 SQ FT OF AIR COLLECTORS, TILTED AT 53 DEGREES, TO COLLECT SOLAR ENERGY DURING THE WINTER AND REJECT HEAT PUMP COOLING ENERGY DURING THE SUMMER. A 40 TON ROCK BED IS USED FOR STORAGE. AUXILIARY HEATING IS SUPPLIED BY THE HEAT PUMP WHICH CONTAINS AN ELECTRIC STRIP HEATER.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	9.746	MILLION BTU
	25380	BTU/SQ.FT.
COLLECTED SOLAR ENERGY	4.296	MILLION BTU
	11187	BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	37	DEGREES F
AVERAGE BUILDING TEMPERATURE	68	DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.14	
ECSS OPERATING ENERGY	0.362	MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	1.150	MILLION BTU
TOTAL ENERGY CONSUMED	6.711	MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	N.A.	2.648	N.A.	2.648 MILLION BTU
SOLAR FRACTION	N.A.	52	N.A.	52 PERCENT
SOLAR ENERGY USED	N.A.	1.382	N.A.	1.382 MILLION BTU
OPERATING ENERGY	N.A.	0.787	N.A.	1.150 MILLION BTU
AUX. THERMAL ENERGY	N.A.	1.265	N.A.	1.265 MILLION BTU
AUX. ELECTRIC FUEL	N.A.	1.265	N.A.	1.265 MILLION BTU
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. MILLION BTU
ELECTRICAL SAVINGS	N.A.	0.842	N.A.	0.479 MILLION BTU
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.329

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978. SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: ZEIN MECHANICAL-NO. 1 SOLAR/1057-78/11
REPORT PERIOD: NOVEMBER,1978

SITE/SYSTEM DESCRIPTION:
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GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	10.282 GIGA JOULES
	288214 KJ/SQ.M.
COLLECTED SOLAR ENERGY	4.532 GIGA JOULES
	127035 KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	3 DEGREES C
AVERAGE BUILDING TEMPERATURE	20 DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.14
ECSS OPERATING ENERGY	0.382 GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	1.213 GIGA JOULES
TOTAL ENERGY CONSUMED	7.080 GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	N.A.	2.793	N.A.	2.793 GIGA JOULES
SOLAR FRACTION	N.A.	52	N.A.	52 PERCENT
SOLAR ENERGY USED	N.A.	1.458	N.A.	1.458 GIGA JOULES
OPERATING ENERGY	N.A.	0.831	N.A.	1.213 GIGA JOULES
AUX. THERMAL ENG	N.A.	1.335	N.A.	1.335 GIGA JOULES
AUX. ELECTRIC FUEL	N.A.	1.335	N.A.	1.335 GIGA JOULES
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. GIGA JOULES
ELECTRICAL SAVINGS	N.A.	0.888	N.A.	0.506 GIGA JOULES
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.329

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28,1978. SOLAR/C004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: ZEIN MECHANICAL-NO. 1
REPORT PERIOD: NOVEMBER,1978

SOLAR/1057-78/11

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	0.776	44	0.020	N	0.01[illegible]	N	0.025
2	0.739	55	0.014	O	0.011	O	0.019
3	0.629	60	0.000	T	0.009	T	0.000
4	0.604	53	0.000		0.009		0.000
5	0.402	55	0.002	A	0.007	A	0.004
6	0.176	44	0.021	P	0.009	P	0.121
7	0.651	41	0.017	P	0.012	P	0.026
8	0.547	47	0.023	L	0.012	L	0.042
9	0.633	50	0.006	I	0.011	I	0.009
10	0.326	48	0.010	C	0.009	C	0.030
11	0.003	42	0.033	A	0.006	A	11.148
12	0.020	39	0.052	B	0.008	B	2.599
13	0.022	48	0.025	L	0.007	L	1.149
14	0.307	32	0.049	E	0.014	E	0.158
15	0.591	30	0.044		0.015		0.075
16	0.241	34	0.074		0.014		0.306
17	0.006	42	0.059		0.008		10.283
18	0.515	38	0.028		0.017		0.055
19	0.610	27	0.052		0.015		0.086
20	0.026	23	0.079		0.011		3.009
21	0.079	22	0.083		0.015		1.049
22	0.001	20	0.089		0.012		86.016
23	0.024	36	0.044		0.011		1.864
24	0.313	28	0.069		0.016		0.219
25	0.577	27	0.052		0.016		0.091
26	0.005	32	0.070		0.011		12.800
27	0.011	31	0.068		0.012		5.275
28	0.434	21	0.091		0.019		0.210
29	0.064	31	0.104		0.018		1.539
30	0.416	15	0.110		0.021		0.265
SUM	9.746	-	1.382	N.A.	0.362	N.A.	-
AVG	0.325	37	0.046	N.A.	0.012	N.A.	0.142
NBS ID	G001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: ZEIN MECHANICAL-NO. 1 SOLAR/1057-78/11
REPORT PERIOD: NOVEMBER,1978

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	0.776	0.755	0.333	55	0.430
2	0.739	0.726	0.332	64	0.450
3	0.629	0.621	0.285	*	0.453
4	0.604	0.596	0.269	57	0.444
5	0.402	0.393	0.176	70	0.437
6	0.176	0.157	0.057	46	0.325
7	0.651	0.632	0.306	50	0.470
8	0.547	0.573	0.227	53	0.415
9	0.637	0.621	0.295	58	0.466
10	0.326	0.313	0.133	54	0.410
11	0.003	0.000	0.000	40	0.000
12	0.020	0.000	0.000	38	0.000
13	0.022	0.013	0.005	53	0.240
14	0.307	0.295	0.117	34	0.382
15	0.591	0.581	0.288	37	0.488
16	0.241	0.187	0.075	38	0.311
17	0.006	0.000	0.000	47	0.000
18	0.515	0.509	0.247	41	0.479
19	0.610	0.593	0.285	30	0.468
20	0.026	0.000	0.000	23	0.000
21	0.079	0.054	0.020	25	0.256
22	0.001	0.000	0.000	*	0.000
23	0.024	0.010	0.006	37	0.241
24	0.313	0.296	0.149	30	0.474
25	0.577	0.573	0.297	31	0.515
26	0.005	0.000	0.000	33	0.000
27	0.011	0.000	0.000	32	0.000
28	0.434	0.425	0.174	19	0.401
29	0.064	0.035	0.019	35	0.295
30	0.416	0.401	0.200	17	0.482
SUM	9.746	9.308	4.296	-	-
AVG	0.325	0.310	0.143	41	0.441
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SITE: ZEIN MECHANICAL-NO. 1 SOLAR/1057-78/11
REPORT PERIOD: NOVEMBER,1978

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.333	0.020	-0.038	101	-0.054
2	0.332	0.014	0.016	102	0.093
3	0.285	0.000	0.040	105	0.140
4	0.269	0.000	0.001	107	0.003
5	0.176	0.002	-0.020	106	-0.107
6	0.057	0.021	-0.134	96	-1.980
7	0.306	0.017	0.014	84	0.101
8	0.227	0.023	0.024	91	0.209
9	0.245	0.006	-0.022	89	-0.055
10	0.133	0.010	0.001	91	0.080
11	0.000	0.033	-0.084	87	1.000
12	0.000	0.052	-0.120	68	1.000
13	0.005	0.025	-0.033	61	-1.503
14	0.117	0.049	0.058	60	0.908
15	0.288	0.044	0.165	70	0.725
16	0.075	0.074	-0.152	70	-1.048
17	0.000	0.069	-0.094	61	1.000
18	0.247	0.028	0.160	60	0.762
19	0.285	0.052	0.098	77	0.527
20	0.000	0.079	-0.251	68	1.000
21	0.020	0.083	-0.035	53	2.531
22	0.000	0.083	-0.068	47	1.000
23	0.006	0.044	0.012	45	9.769
24	0.149	0.069	0.124	48	1.300
25	0.297	0.052	0.149	61	0.677
26	0.000	0.070	-0.226	52	1.000
27	0.000	0.068	-0.044	49	1.000
28	0.174	0.091	0.063	50	0.845
29	0.019	0.104	-0.083	45	1.151
30	0.000	0.110	0.049	47	0.795
SUM	4.296	1.382	-0.430	-	-
AVG	0.143	0.046	-0.014	72	0.322
NBS ID	0200	0201	0202		N108

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: ZEIN MECHANICAL-NO. 1
REPORT PERIOD: NOVEMBER, 1978

SOLAR/1057-78/11

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.036	55	0.020	0.010	0.016	0.016	N	0.013	N	69	44
2	0.026	56	0.014	0.007	0.011	0.011	O	0.010	O	71	55
3	0.000	0	0.000	0.000	0.000	0.000	T	0.000	T	72	60
4	0.000	0	0.000	0.000	0.000	0.000		0.000		72	53
5	0.005	33	0.002	0.002	0.003	0.003	A	0.000	A	70	55
6	0.049	45	0.021	0.015	0.028	0.028	P	0.011	P	68	44
7	0.036	48	0.017	0.011	0.019	0.019	P	0.009	P	69	41
8	0.047	49	0.023	0.015	0.024	0.024	L	0.013	L	68	47
9	0.014	39	0.006	0.005	0.009	0.009	I	0.002	I	71	50
10	0.021	47	0.010	0.007	0.011	0.011	C	0.005	C	69	48
11	0.066	51	0.033	0.020	0.032	0.032	A	0.020	A	68	42
12	0.097	54	0.052	0.028	0.045	0.045	B	0.033	B	68	39
13	0.054	46	0.025	0.018	0.030	0.030	L	0.012	L	68	48
14	0.098	50	0.049	0.030	0.049	0.049	E	0.028	E	68	32
15	0.083	53	0.044	0.024	0.039	0.039		0.028		68	30
16	0.135	55	0.074	0.038	0.061	0.061		0.048		68	34
17	0.107	56	0.059	0.029	0.047	0.047		0.039		68	42
18	0.059	48	0.028	0.019	0.031	0.031		0.015		68	38
19	0.097	54	0.052	0.028	0.045	0.045		0.033		68	27
20	0.142	55	0.079	0.039	0.063	0.063		0.052		67	23
21	0.151	55	0.083	0.043	0.069	0.069		0.053		67	22
22	0.152	55	0.083	0.043	0.069	0.069		0.053		67	26
23	0.093	47	0.044	0.031	0.049	0.049		0.035		68	36
24	0.132	52	0.069	0.040	0.063	0.063		0.042		67	28
25	0.102	51	0.052	0.031	0.050	0.050		0.031		68	27
26	0.133	53	0.070	0.039	0.062	0.062		0.043		67	32
27	0.133	51	0.068	0.041	0.065	0.065		0.041		67	31
28	0.175	52	0.091	0.053	0.084	0.084		0.055		67	21
29	0.195	53	0.104	0.057	0.091	0.091		0.065		67	31
30	0.211	52	0.110	0.064	0.101	0.101		0.067		67	15
SUM	2.648	-	1.382	0.787	1.255	1.255	N.A.	0.842	N.A.	-	-
AVG	0.088	52	0.046	0.026	0.042	0.042	N.A.	0.028	N.A.	68	37
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q418	Q417	N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE COOLING SUBSYSTEM

SITE: ZEIN MECHANICAL-NO. 1
REPORT PERIOD: NOVEMBER,1978

SOLAR/1057-78/11

DAY OF MON.	SPACE COOLING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG DRY BULB TEMP F	AMB TEMP DEG F
1	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	69	44
2										71	55
3										72	60
4										72	53
5										70	55
6										68	44
7										69	41
8										68	47
9										71	50
10										69	48
11										68	42
12										68	39
13										68	48
14										53	32
15										68	30
16										68	34
17										68	42
18										68	38
19										68	27
20										67	23
21										67	22
22										67	26
23										68	36
24										67	28
25										68	27
26										67	32
27										67	31
28										67	21
29										67	31
30										57	15
SUM	N.A.	-	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	-	-
AVG	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	68	37
NBS	Q502	N500	Q500	Q503	Q501		Q506	Q512	Q514	N406	N113

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: ZEIN MECHANICAL-NO. 1
REPORT PERIOD: NOVEMBER,1978

SOLAR/1057-78/11

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	2020	N	44	55	N	N	N
2	1923	O	55	64	O	O	O
3	1637	T	60	*	T	T	T
4	1574		53	57			
5	1047	A	55	70	A	A	A
6	458	P	44	46	P	P	P
7	1695	P	41	50	P	P	P
8	1424	L	47	53	L	L	L
9	1649	I	50	58	I	I	I
10	848	C	48	54	C	C	C
11	8	A	42	40	A	A	A
12	53	B	39	38	S	B	B.
13	56	L	48	52	L	L	L
14	800	E	32	34	E	E	E
15	1540		30	37			
16	528		34	38			
17	15		42	47			
18	1341		38	41			
19	1588		27	30			
20	68		23	23			
21	205		22	23			
22	3		26	*			
23	62		36	37			
24	816		28	30			
25	1504		27	31			
26	14		32	[illegible]			
27	28		31	32			
28	1129		21	19			
29	166		31	35			
30	1083		15	17			
SUM	25380	N.A.	-	-	-	-	-
AVG	846	N.A.	37	41	N.A.	N.A.	N.A.
NBS ID	Q001		N113			N115	N114

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